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addition of factors to the ideal world will be an endless process, and the ideal world can never coincide in all points with the actual.

In conclusion, any event is thus determined to be what it is in every detail by the conditions that are on hand at the time of eventuation. Looking at the present and past, determination is always discernible to appropriate scrutiny. Looking ahead, there is only the approximate determination such as we know in science. To speak absolutely, any event is finally and exactly determined only in the fact of actual eventuation.

W. H. KILPATRICK.

TEACHERS COLLEGE, COLUMBIA UNIVERSITY.

CHANCE AS A CATEGORY OF SCIENCE

TERMS slip easily from popular usage into the technical vocabulary of logic. We often employ the word *chance* as a general synonym of ignorance, while science has accepted a usage which makes chance the antithesis of law. There arises, therefore, the problem of the nature of chance as a category of thought, for upon a distinct and unequivocal interpretation of the term depends alone its legitimate use in science.

There are two possible attitudes we may assume regarding the concept of chance. On the one hand, we may look upon a usage which simply passes over the logical issues and regards chance as merely a shroud for obscuring our veritable ignorance of the true causes of an event. Such a point of view makes chance subjective. On the other hand, we may regard the term as indicating a serviceable, scientific concept, having a significance in the logic of the sciences, a significance which gives chance a distinct and definable value. This point of view makes chance objective.

The usage of chance which makes it depend solely on human ignorance is the immediate postulate of a metaphysical assumption. If we presume, as a fact of reality, that law and order are universal throughout nature, then nothing ever occurs by chance, but is the immediate result of definable laws. If, with this in mind, we speak of the chance occurrence of an event we simply imply that we fail to comprehend the laws upon which the event depends, although we recognize that somewhere in the vast totality of nature's order the event would find an adequate and full explanation. There is no chance from the point of view of the absolute; the postulate of the ultimate uniformity of nature destroys chance with one stroke of the pen and makes all lapse of regularity the lapse of human knowledge.

But this brushing away of chance from our speech is merely a postulate of a deeper metaphysical theory. It has not touched the problem of its logical value as a scientific category. The fact remains, over and above the postulate of absolute law, that science and the demands of our ordinary speech require a concept that shall express the permanent doubt of an event, whatsoever our ultimate world-formula may be. Five red balls and five black balls are in a bag. From the arrangement of the balls, the folds of the bag, the movement of my fingers, and the configuration of the dendrites of my brain, it may be determined in an absolute sense which ball I first draw out, but these considerations are not part of the immediate circumstances at issue. We want a term which shall express the indeterminate character of the forthcoming event. That term is chance. Science demands its employment in a thousand instances, and the logic of the sciences must prescribe a usage which makes it legitimate. And all this without any reference to absolute law and regularity.

The problem of chance is not concerned with the organization and uniformity of all nature, for the simple reason that no scientific problem ever embraces the universe. The chemist must deal with the molecular constitution of quartz without discussing the period of the earth's history in which the quartz congealed, nor the seismic convulsions which accompanied its formation. In an absolute sense all knowledge may be relative—that is a metaphysical issue—but in the precise sense of a scientific investigation all the facts of the problem are restricted to a limitable universe of discourse. In these definite confines chance arises. It can, therefore, have an objective and valid meaning in a world ultimately causal and sequential, simply because the scientific problem in which chance occurs is not the problem of all human knowledge. We may accept or reject the metaphysical premise of an absolute world-order, where at the last extremity all is law and nothing chance. Nevertheless, the logical problem remains.

Chance is bound up with certain types of scientific categories which enable us to describe experiences. In describing experience we must first limit it. When DeVries speaks of the occurrence of a mutant or sport variety of a species as the result of chance, he is contrasting chance with law in the limited sphere of germ cells, inheritable characters and similar biological phenomena. McDougall's observations that the occurrence of mutants can be influenced by salt solutions is a chemical fact not included originally in the definitely limited universe of discourse in which the chance mutant may be said to occur. This chemical fact may be added to the original universe of discourse of germ cells and inheritable characters by enlarging it by just so much. The fact remains, however, that the universe of discourse, in which the chance mutant occurs is, to the minds of the students of genetics, limited and precise.

This limiting of the sphere of a scientific problem determines the solution of the problem. If the biologist so defines the problem of heredity that chemical phenomena are excluded from its definite boundaries, then chemistry can have no effect on the solution which the biologist ultimately reaches. It is out of the matter by arbitrary exclusion. Of course, a scientist will make his original universe of discourse as large as he deems necessary, but it will always remain arbitrary and determined, simply because it can not include all nature. It must be small to be workable. It must be precise to be thoroughly understood.

This determines for each scientific problem a limited horizon within which the conditions of solution are supposed to lie. The labor in solving the problem is the labor of categorizing and systematizing the facts within this limited universe of discourse. And a solution arises when some regularity is observable. We call that observed regularity a law. When no observed regularity is evident, one event happening apparently without sequential relations to other events of the universe of discourse, we may call the occurrence of that event *chance*. It is, therefore, merely the absence of sequential regularity within the universe of discourse of the problem.

According to this interpretation, law is the successful reduction to some principle of order of certain phenomena within a limited universe of discourse. Chance arises when no regularity is observable. The occurrence of a mutant in the limited universe of discourse with which DeVries and other biologists deal in their problems of genetics is a chance occurrence simply because these biologists are unable to discover any regularity underlying the occurrence of such phenomena. Were the universe of discourse to be much enlarged, say by the introduction of many chemical and physical facts, it is possible that what now appears as chance would then become law. But for the universe of discourse at present considered the event can only be explained in terms of chance. This theory of chance, therefore, makes chance and law relative terms dependent upon the extent of the universe of discourse within which the scientist hopes to solve his problem.

Such a theory of chance indicates that the step between chance and law may depend on nothing more vital than the limits by which the problem was originally circumscribed. Chance and law are not antitheses of one another, but simply terms which are relative to the success or lack of success with which we find regularity in the universe of discourse of any scientific problem. Moreover, the occurrence of a chance event may be explained without denying the general uniformity of nature, for it would be observed that the process of reducing chance to law is a process of discovering the two sets of conditions, within and without the definite universe of discourse, upon which it depends. Let α represent the occurrence of a chance event, such as the drawing of a black ball or the occurrence of a mutant. Let $a, b, c \ldots$ represent the conditions within the immediate universe of discourse of the problem. For example, in the case of a mutant they are conditions inherent in the structure of the germ cells and the like, which the biologist is bound to take into consideration. And let $m, n, o \ldots$ be certain external conditions without the universe of discourse; in the example in question they are those conditions which the biologist has not deemed worthy of considering, as for instance, the effect of atmosphere and chemicals upon germ cells. Chance would be represented by the formula $\alpha = f(a, b, c \ldots m, n, o \ldots)$. Then according to this formula, the chance event α becomes a function of these two separate sets of conditions, the one confined entirely to the universe of discourse of the problem, and the other set lying without it. The reduction of chance to law consists in the determination of such values for $a, b, c \ldots$ and $m, n, o \ldots$ as to bring regularity into such a new universe of discourse as will include all these conditions.

ARTHUR DEWING.

HARVARD UNIVERSITY.

REVIEWS AND ABSTRACTS OF LITERATURE

Psychology and the Teacher. HUGO MÜNSTERBERG. New York: D. Appleton & Co. 1909. Pp. 325.

Part I. In this age of pedagogical unrest, Münsterberg welcomes the possibility of a more intimate connection of laboratory psychology with schoolroom operations. The unpardonable sins of pedagogy have been vagueness and failure to utilize the most vital psychological discoveries, chiefly because of the lack of articulate ideals of the end in view. Laws of attention, memory, or interest, though true, may not necessarily be pertinent to educational situations. No facts *per se* yield educational guidance. Practical pedagogics, for example, becomes vicious when a wholesale carrying-over of laws of interest results. The foolish inference in this classic example of pedagogical fallacy is that we must let the child *illustrate* the psychological laws of interest, thereby bringing about chaos of aims and subversion of sound development.

An ethical inquiry, then, must supplement a psychological one. From the points of view of biology, psychology, and sociology we may analyze the processes and discover suitable methods of procedure, but science as